

Overview of Diabetes in Children and Adolescents

From the [National Diabetes Education Program \(NDEP\)](#)

Introduction

Diabetes mellitus is a group of diseases characterized by high levels of glucose in the blood resulting from defects in insulin production, insulin action, or both. Diabetes is associated with serious complications, but timely diagnosis and treatment of diabetes can prevent or delay the onset of long-term complications (damage to the cardiovascular system, kidneys, eyes, nerves, blood vessels, skin, gums, and teeth). New management strategies are helping children with diabetes live long and healthy lives.

Diabetes is one of the most common diseases in school-aged children. About 208,000 young people in the US under age 20 had diabetes in 2012¹ Both type 1 diabetes² and type 2 diabetes are increasing in U.S. children and adolescents. The Centers for Disease Control and Prevention provides statistics about in the [National Diabetes Statistics Report, 2014](#).

The American Diabetes Association provides helpful guidance in a consensus statement for managing children with type 1 diabetes.³ The American Diabetes Association offers a consensus statement⁴ and the American Academy of Pediatrics offers clinical practice guidelines⁵ for the management of type 2 diabetes in children. To update primary care providers, school health personnel, and other health care professionals about this evolving area of diabetes care, the NDEP has developed this overview of current statistics and care recommendations.

Type 1 Diabetes

Type 1 diabetes accounts for approximately 5 percent of all diagnosed cases of diabetes, but is the leading cause of diabetes in children of all ages. Type 1 diabetes accounts for almost all diabetes in children less than 10 years of age. Type 1 diabetes is an autoimmune disease in which the immune system destroys the insulin-producing beta cells of the pancreas that help regulate blood glucose levels.

Onset: Type 1 diabetes mostly has an acute onset, with children and adolescents usually able to pinpoint when symptoms began. Onset can occur at any age. Children and adolescents may present with ketoacidosis as the first indication of type 1 diabetes. Others may have post-meal hyperglycemia, or modest fasting hyperglycemia that rapidly progresses to severe hyperglycemia and/or ketoacidosis in the presence of infection or other stress.

Symptoms: The immunologic process that leads to type 1 diabetes can begin years before the symptoms of type 1 diabetes develop. Symptoms become apparent when most of the beta-cell population is destroyed and usually develop over a short period of time. Early symptoms, which are mainly due to hyperglycemia, include increased thirst and urination, constant hunger, weight loss, and blurred vision. Children also may feel very tired.

As insulin deficiency worsens, ketones, which are formed from the breakdown of fat, build up in the blood and are excreted in the urine and breath. Increased ketones are associated with shortness of breath and abdominal pain, vomiting, and worsening dehydration. Elevation of blood glucose, acidosis, and dehydration comprise the condition known as diabetic ketoacidosis or DKA. If diabetes is not diagnosed and treated with insulin at this point, the individual can lapse into a life-threatening coma. Often, children with vomiting are mistakenly diagnosed as having gastroenteritis. New-onset diabetes can be differentiated from gastroenteritis by the frequent urination that accompanies continued vomiting, as opposed to decreased urination due to dehydration if the vomiting is caused by gastroenteritis.

Risk Factors: A combination of genetic and environmental factors put people at increased risk for type 1 diabetes. Researchers have identified many factors and continue working so that targeted treatments can be designed to stop the autoimmune process that destroys the pancreatic beta-cells.

Predicting Type 1 Diabetes: As type 1 diabetes is caused by immune destruction of the insulin-producing beta cells in the pancreatic islets, antibodies against islets' proteins are found in children and adolescents months to years

before the onset of diabetes. Evidence from several studies suggests that measurement of islet autoantibodies in relatives of those with type 1 diabetes identifies new individuals who are at risk for developing type 1 diabetes. Such testing, coupled with education about symptoms of diabetes and follow-up in an observational clinical study, may allow earlier identification of onset of type 1 diabetes and lessen presentation with ketoacidosis at time of diagnosis. This testing may be appropriate in those who have relatives with type 1 diabetes, in the context of clinical research studies (see, for example, <http://www.diabetestrialnet.org>).⁶

Co-morbidities: Children with type 1 diabetes are at risk for the long-term complications of diabetes. Autoimmune diseases such as celiac disease and autoimmune thyroid disease are also associated with type 1 diabetes.

Management: The basic elements of type 1 diabetes management are insulin administration (either by injection or insulin pump), nutrition management, physical activity, blood glucose testing, and the development of strategies to avoid hypoglycemia and hyperglycemia that may lead to DKA. Algorithms are used for insulin dosing based on blood glucose level, food intake, physical activity, and illness, if present.

All people with diabetes are advised to avoid “liquid carbs (carbohydrates)” such as sugar-containing soda, sports or energy drinks, juices (including 100 percent fruit juice), and regular pancake syrup. These liquid carbs raise blood glucose rapidly, contain large amounts of sugars in small volumes, are hard to balance with insulin, and provide little or no nutrition.

Children receiving fixed insulin doses of intermediate- and rapid-acting insulins must have food given at the time of peak action of the insulin. They need a consistent meal plan that aims for a set amount of carb grams at each meal (e.g., 60 grams of carbs at lunch) and snack since they do not adjust their mealtime insulin for the amount of carb intake.

Children receiving a long-acting insulin analogue or using an insulin pump receive a rapid-acting insulin analogue just before meals, with the amount of pre-meal insulin based on carb content of the meal using an insulin to carb ratio and a correction scale for hyperglycemia. Carb counting involves calculating the number of grams of carbohydrate, or choices of carbohydrate, the youth eats. One carb choice equals 15 grams of carbohydrate. Sources of carbs include starches (breads, crackers, cereal, pasta, rice), fruits and vegetables, dried beans and peas, milk, yogurt and sweets. In addition to the amount of insulin needed to cover the carbs (called the carb dosage), extra insulin might be needed if the youth’s blood glucose is above the target range before a meal or snack. Further adjustment of insulin or food intake may be made based on anticipation of special circumstances such as increased exercise and intercurrent illness. Children on these regimens are expected to check their blood glucose levels routinely before meals and at bedtime.

Physical activity is a critical element of effective diabetes management. In addition to maintaining cardiovascular fitness and controlling weight, physical activity can help to lower blood glucose levels. To maintain blood glucose levels within the target range during extra physical activity, students will need to adjust their insulin and food intake. They also may need to check their blood glucose levels more frequently to prevent hypoglycemia while engaging in physical activity.

Families need to work with their health care team to set target blood glucose levels appropriate for the child. To control diabetes and prevent complications, the American Diabetes Association suggests blood glucose and A1C goals for type 1 diabetes by age group (http://care.diabetesjournals.org/content/37/Supplement_1/S14/T14.expansion.html). For more information about managing diabetes in children, see NDEP’s *Helping the Student with Diabetes Succeed: A Guide for School Personnel* at <http://ndep.nih.gov/publications/PublicationDetail.aspx?PubId=97>.

Key concepts in setting glycemic goals

Goals should be individualized and lower or higher goals may be reasonable based on benefit-risk assessment. While achieving near-normal glucose levels helps prevent the development of complications, blood glucose goals should be adjusted in children with frequent hypoglycemia or hypoglycemia unawareness. Postprandial blood glucose values should be measured when there is a discrepancy between pre-prandial blood glucose values and A1C levels, and to help assess glycemia in those on basal/bolus regimens.

Type 2 Diabetes

Type 2 diabetes used to occur mainly in adults who were overweight and older than 40 years. Now, as more children and adolescents in the United States become overweight or obese and inactive, type 2 diabetes is occurring more often in young people aged 10 or older. Most children and adolescents diagnosed with type 2 diabetes are also insulin resistant, and have a family history of type 2 diabetes. Type 2 diabetes is more common in certain racial and ethnic groups such as African Americans, American Indians, Hispanic/Latino Americans, and some Asian and Pacific Islander Americans.¹

The increased incidence of type 2 diabetes in youth is a first consequence of the obesity epidemic among young people, and is a significant and growing public health problem.⁷

Results from the 2007-2008 National Health and Nutrition Examination Survey (NHANES), using measured heights and weights, indicate that an estimated 16 to 17 percent of children and adolescents ages 2 to 19 years had a BMI greater than or equal to the 95th percentile of the age- and sex-specific BMI— about double the number of two decades ago.⁸ The Centers for Disease Control and Prevention's (CDC) BMI and growth curves calculate body fatness in children (www.cdc.gov/nccdphp/dnpa/bmi/index.htm).

Onset: The first stage in the development of type 2 diabetes is often insulin resistance, requiring increasing amounts of insulin to be produced by the pancreas to control blood glucose levels. Initially, the pancreas responds by producing more insulin, but after several years, insulin production may decrease and diabetes develops. Type 2 diabetes usually develops slowly and insidiously.

Symptoms: Some children or adolescents with type 2 diabetes may show no symptoms at all. In others, symptoms may be similar to those of type 1 diabetes. A youth may feel very tired, thirsty, or nauseated and have to urinate often. Other symptoms may include weight loss, blurred vision, frequent infections, and slow healing of wounds or sores. Some youth may present with vaginal yeast infection or burning on urination due to yeast infection. Some may have extreme elevation of the blood glucose level associated with severe dehydration and coma. Because symptoms are varied, it is important for health care providers to identify and test youth who are at high risk for the disease.

Signs of Diabetes: Physical signs of insulin resistance include acanthosis nigricans, where the skin around the neck or in the armpits appears dark and thick, and feels velvety. Girls can have polycystic ovary syndrome with infrequent or absent periods, and excess hair and acne. Microalbuminuria and cardiovascular risk factors such as abnormal cholesterol and high blood pressure may be present at the time of diagnosis.⁹

Diabetes Risk Factors and Testing Criteria: Current diabetes risk factors and testing criteria in Table 2 help identify type 2 diabetes in children before the onset of complications.⁶

Table 2. Type 2 Diabetes Risk Factors and Testing Criteria.

Overweight (BMI >85th percentile for age and gender; weight for height >85th percentile; or weight >120 percent of ideal for height)

PLUS

Any two of the following risk factors

- family history of type 2 diabetes in first- or second-degree relative
- race/ethnicity – American Indian, African American, Hispanic/Latino, Asian American, or Pacific Islander
- signs of insulin resistance or conditions associated with insulin resistance (acanthosis nigricans, hypertension, dyslipidemia, polycystic ovarian syndrome, or small-for-gestational-age birth weight)
- maternal history of diabetes or GDM during the child's gestation

Age to begin testing – 10 years old or at onset of puberty if puberty occurs earlier

Frequency of testing – every 3 years

Tests to use – fasting plasma glucose, A1C, 2-h oral glucose tolerance test

Clinical judgment should be used to perform testing in children and adolescents who do not meet the above criteria.

Co-morbidities: Children with type 2 diabetes also are at risk for the long-term complications of diabetes and the co-morbidities associated with insulin resistance (lipid abnormalities and hypertension). Recent studies show that the onset of complications and co-morbidities and the speed of progression is particularly aggressive in youth with type 2 diabetes.¹⁰

Management: Although there are no national recommendations for blood glucose levels in children with type 2 diabetes, it may be reasonable to use the values in Table 1 (for children with type 1) as a guide. All aspects of the regimen need to be individualized.

The cornerstone of diabetes management for children with type 2 diabetes is healthy eating with portion control, and increased physical activity. Metformin should also be initiated at the time of diagnosis of type 2 diabetes. However, research shows that approximately half of youth with type 2 diabetes will be unable to maintain A1C less than 8 percent on metformin alone, with or without lifestyle change.¹¹

If metformin is not sufficient to normalize blood glucose levels, the addition of insulin may be needed. While there are numerous other oral medications for use in adults, they are not approved in children. Insulin may be taken by injection or via a subcutaneous pump.

It is also recommended that blood pressure measurement, a fasting lipid profile, microalbuminuria assessment, and dilated eye examination be performed at the time of diagnosis.⁶ Thereafter screening guidelines and treatment recommendations are similar to youth with type 1 diabetes.

Other Forms of Diabetes

Other types of diabetes result from specific genetic conditions (such as maturity-onset diabetes of youth or latent autoimmune diabetes in adults), surgery, medications, infections, pancreatic disease, and other illnesses. Such types of diabetes account for 1% to 5% of all diagnosed cases.

Management Considerations for all Children with Diabetes

There is no single approach to manage diabetes that fits all children. Blood glucose targets, frequency of blood glucose testing, type, dose and frequency of insulin, use of insulin injections with a syringe or a pen or pump, use of oral glucose-lowering medication and details of nutrition management all may vary among individuals. The family

and diabetes care team determine the regimen that best suits each child's individual characteristics and circumstances. (See NDEP tip sheet series for youth with diabetes at <http://ndep.nih.gov/teens/index.aspx>.)

Hypoglycemia: Diabetes treatment can sometimes cause hypoglycemia (low blood glucose levels). Taking too much insulin, missing a meal or snack, strenuous exercise, or illness may cause hypoglycemia. In addition, hypoglycemia can occur with no apparent cause. A child can become irritable, shaky, or confused. When blood glucose levels fall very low, loss of consciousness or seizures may develop.

When hypoglycemia is recognized, the child should drink or eat 15 grams of a glucose-containing carbohydrate source to quickly raise the blood glucose to normal levels. Examples of 15 grams of carbohydrate include 3 or 4 glucose tablets, or 4 ounces of fruit juice (not low-calorie or reduced sugar). The blood glucose should be rechecked in 10-15 minutes and re-treated with carbohydrate if hypoglycemia persists. Once the blood glucose returns to normal, the child can eat a meal or snack to prevent recurrence of hypoglycemia. If the child is unable to eat or drink, glucagon should be administered. Frequent hypoglycemia or a single episode of severe hypoglycemia warrants review of treatment plan (medicine, diet, and activity) to avoid recurrent episodes.

Glycemic goals may need to be modified to take into account the fact that most children younger than 6 or 7 years of age have a form of "hypoglycemic unawareness." They lack the cognitive capacity to recognize and respond to hypoglycemic symptoms and may be at greater risk for hypoglycemia. Children under 5 years of age may be at risk for permanent cognitive impairment after episodes of severe hypoglycemia.²

Hyperglycemia: Causes of hyperglycemia include forgetting to take medications on time, eating too much, getting too little exercise, and stress. Some episodes of hyperglycemia may occur without an apparent reason. Being ill also can raise blood glucose levels. Over time, hyperglycemia can cause damage to the eyes, kidneys, nerves, blood vessels, gums, and teeth. Neurocognitive complications of hyperglycemia have also been documented.⁶

Sick-day management rules, including assessment for ketosis with every illness, must be established for children with type 1 diabetes. Families need to be taught what to do for vomiting and for ketosis to prevent severe hyperglycemia and ketoacidosis.¹²

Monitoring Complications and Reducing CVD Risk

The following recommendations are based on the American Diabetes Association's Standards of Medical Care unless noted otherwise.⁶

Retinopathy: Although retinopathy most commonly occurs after the onset of puberty and after 5 to 10 years of diabetes duration, it has been reported in prepubertal children and with diabetes duration of only 1 to 2 years. Referrals should be made to eye care professionals with expertise in diabetic retinopathy, an understanding of the risk for retinopathy in the pediatric population, as well as experience in counseling the pediatric patient and family on the importance of early prevention/intervention. For children with type 1 diabetes, the first ophthalmologic examination should be obtained once the child is 10 years of age or older and has had diabetes for 3 to 5 years. In type 2 diabetes, the initial examination should be shortly after diagnosis. In type 1 and type 2 diabetes, annual routine follow-up is generally recommended. Less frequent examinations may be acceptable on the advice of an eye care professional.

Nephropathy: To reduce the risk and/or slow the progression of nephropathy, optimize glucose and blood pressure control. For children with type 1 diabetes, annual screening for microalbuminuria should be initiated once the child is 10 years of age and has had diabetes for 5 years. In type 2 diabetes, annual screening should be considered at diagnosis. Screening may be done with a random spot urine sample analyzed for microalbumin-to-creatinine ratio. Confirmed, persistently elevated microalbumin levels should be treated with an ACE inhibitor, titrated to normalization of microalbumin excretion if possible.

Neuropathy: Although it is unclear whether foot examinations are important in children and adolescents, annual foot examinations are painless, inexpensive, and provide an opportunity for education about foot care. The risk for foot complications is increased in people who have had diabetes over 10 years.

Lipids: Based on data obtained from studies in adults, having diabetes is equivalent to having had a heart attack,

making diabetes a key risk factor for future cardiovascular disease.

Children with diabetes should have a lipid profile at puberty (greater than 10 years) or at diagnosis, if less than 10 years, after glucose control has been established. If lipids are abnormal, monitor annually. If lipid values fall within the accepted risk levels (LDL-cholesterol less than 100 mg/dl), repeat the lipid profile every 5 years.

The goal for LDL-cholesterol in children and adolescents with diabetes is less than 100 mg/dl. If the LDL-cholesterol is greater than 100 mg/dl, the child should be treated with medical nutrition therapy using a Step 2 American Heart Association diet. Weight loss, increased physical activity, and improvement in glycemic control often result in improvements in lipid levels. If, after 6 months of lifestyle changes, the LDL-cholesterol level remains above 160 mg/dl, a statin should be given. If, the LDL-cholesterol is between 130 and 160 mg/dl and the patient has one or more cardiovascular disease risk factors, statin therapy should be considered. Statins are not approved for use in children less than 10 years. Adolescent females should receive counseling about potential negative effects of statins on a developing fetus.

Blood pressure: Careful control of hypertension in children is critical. Normal blood pressure levels for age, sex, and height, appropriate methods for measurement, and treatment recommendations are available online at www.nhlbi.nih.gov/health/heart/hbp/hbp_ped.pdf.¹³ Pharmacological treatment of hypertension (systolic or diastolic blood pressure above the 95th percentile for age, sex, and height or consistently greater than 130/80) should be considered. ACE inhibitors should be considered for the treatment of hypertension in children. Adolescent females should receive counseling about potential negative effects of ACE inhibitors on a developing fetus. ACE inhibitors have beneficial effects on slowing progression or preventing diabetic nephropathy. The goal of treatment is a blood pressure consistently less than 130/80 or below the 90th percentile for age, sex, and height, whichever is lower.

Visiting the Health Care Team

Ideally, diabetes care for youth with diabetes should be provided by a team that can deal with the special medical, educational, nutritional, and behavioral issues associated with children and teens. The team usually consists of a physician, diabetes educator, dietitian, social worker or psychologist, along with the patient and family. Children should be seen by the team at diagnosis and in follow-up, as agreed upon by the primary care provider and the diabetes team. The following schedule of care is based on the American Diabetes Association's Standards of Medical Care.⁶

At Diagnosis

- Establish the goals of care and required treatment
- Begin diabetes self-management education about healthy eating habits, daily physical activity, and insulin/medication administration, and self-monitoring of blood glucose levels if appropriate (a solid educational base is needed so that the individual and family can become increasingly independent in self-management of diabetes; diabetes educators play an important role in this aspect of management)
- Provide nutritional therapy by an individual experienced with the nutritional needs of the growing child and the behavioral issues that have an impact on adolescent diets
- Conduct a psychosocial assessment to identify emotional and behavioral disorders
- Check lipids as noted above
- Check for celiac disease in type 1 diabetes
- Check for microalbumin in type 2 diabetes
- Provide ophthalmologic examination shortly after diagnosis in type 2 diabetes

Each Quarterly Visit

Most young people with diabetes are seen by the health care team every 3 months. At each visit, the following should be monitored or examined

- A1C, an indicator of average blood glucose control
- Growth (height and weight)
- BMI
- Blood pressure

- Injection sites
- Self-testing blood glucose records
- Psychosocial adjustment

Annually

- Evaluate nutrition therapy
- Provide ophthalmologic examination as noted above
- Check for microalbuminuria as noted above
- Perform thyroid function test (for children with type 1 diabetes)
- Administer influenza vaccination
- Examine feet

Helping Children and Adolescents Manage Diabetes

The health care professional team, in partnership with the young person with diabetes and parents or other caregivers, needs to develop a personal diabetes management plan and daily schedule. The plan helps the child or teen to follow a healthy meal plan, get regular physical activity, check blood glucose levels, take insulin or oral medication as prescribed, and manage hyperglycemia and hypoglycemia. See NDEP's Diabetes HealthSense searchable database of tools, programs, and research that helps people make lifestyle and behavior changes at <http://ndep.nih.gov/resources/diabetes-healthsense>.

Follow a healthy meal plan: Young people with diabetes need to follow a meal plan developed by a registered dietitian, diabetes educator, or physician. For children with diabetes, the meal plan should outline appropriate changes in eating habits that ensure proper nutrition for growth and reduce or prevent obesity. A meal plan also helps keep blood glucose levels in the target range.

Children or adolescents and their families can learn how different types of food – especially carbohydrates such as breads, pasta, and rice – can affect blood glucose levels. Portion sizes, the right amount of calories for the child's age and activity level, and ideas for healthy food choices at meal and snack time also should be discussed, including reduction in soda and juice intake. Family support for following the meal plan and setting up regular meal times are keys to success, especially if the child or teen is taking insulin. See NDEP tip sheet series for youth with diabetes at <http://ndep.nih.gov/teens/index.aspx>.

For information about healthy eating for all children, visit the Weight-control Information Network (WIN) at <http://win.niddk.nih.gov/publications/index.htm> and the American Diabetes Association at <http://www.diabetes.org/food-and-fitness/food/?loc=ff-slabnav>.

Get regular physical activity: Children with diabetes need regular physical activity, ideally a total of 60 minutes each day. Physical activity helps to lower blood glucose levels and increase insulin sensitivity. Physical activity is also a good way to help children control their weight. In children with type 1 diabetes, the most common problem encountered during physical activity is hypoglycemia. If possible, a child or a teen should check blood glucose levels before beginning a game or a sport. If blood glucose levels are too low, the child should not be physically active until the low blood glucose level has been treated.

For more information on helping children be physically active, visit the NDEP tip sheet series for youth with diabetes at <http://ndep.nih.gov/teens/index.aspx>, the Weight-control Information Network (WIN) at <http://win.niddk.nih.gov/publications/index.htm>, and the Centers for Disease Control and Prevention's (CDC) Verb campaign at www.cdc.gov/youthcampaign/ and www.cdc.gov/HealthyYouth/physicalactivity/.

Check blood glucose levels regularly: Young people with diabetes should know the acceptable range for their blood glucose. Children, particularly those using insulin, should check blood glucose values regularly with a blood glucose meter, preferably one with a built-in memory. A health care team member can teach the child or teen how to use a blood glucose meter properly and how often to use it. Children should keep a journal or other records such as downloaded computer files of their glucose meter results to discuss with their health care team. This information helps providers make any needed changes to the child's or teen's personal diabetes plan.

Continuous Glucose Monitoring Systems: Continuous glucose monitoring systems are available for young people and adults with type 1 diabetes. All continuous glucose sensing systems have the same basic components: a sensor that is placed underneath the skin to measure interstitial glucose (the glucose found in the fluid between cells), a small transmitter worn on the body that connects to the sensor, and a hand-held cell-phone sized receiver that displays the current glucose levels and trends. Some systems integrate the receiver into an insulin pump, thereby reducing the number of extra components that need to be carried.

By having more glucose values available, users are able to see trends and better understand the effects of different foods, exercise, stress, and illness. Receivers sound an alarm when the person's glucose level drops below or goes above a certain pre-set level and in some systems when the projected glucose level will be high or low in 10 or 20 minutes, giving users a chance to prevent high or low blood glucose with early treatment.

Take all diabetes medication as prescribed. Parents, caregivers, school nurses, and others can help a child or teen learn how to take medications as prescribed. For type 1 diabetes, a child or teen takes insulin at prescribed times each day via multiple injections or an insulin pump. Some young people with type 2 diabetes need oral medication or insulin or both. In any case, it is important to stress that all medication should be balanced with food and activity every day. See NDEP's *Helping the Student with Diabetes Succeed: A Guide for School Personnel* for more on insulin management and insulin pump therapy at <http://ndep.nih.gov/publications/PublicationDetail.aspx?PubId=97>.

Special Issues

Care of children and teens with diabetes requires integration of diabetes management with the complicated physical and emotional growth needs of children, adolescents, and their families, as well as consideration of teens' emerging autonomy and independence.

Diabetes presents unique issues for young people with the disease. Simple things, such as going to a birthday party, playing sports, or staying overnight with friends, need careful planning. Checking blood glucose, making correct food choices, and taking insulin or oral medication can make school-age children feel "different" from their classmates and this can be particularly bothersome for teens.

For any child or teen with diabetes, learning to cope with the disease is a big task. Dealing with a chronic illness such as diabetes may cause emotional and behavioral challenges, sometimes leading to depression. Talking to a social worker or psychologist may help young people and their families learn to adjust to the lifestyle changes needed to stay healthy.

Family Support. Managing diabetes in children and adolescents is most effective when the entire family gets involved. Diabetes education should involve family members. Families can be encouraged to share concerns with physicians, diabetes educators, dietitians, and other health care team members to get their help in the day-to-day management of diabetes. Extended family members, teachers, school nurses, counselors, coaches, day care providers, and others in the community can provide information, support, guidance, and help with coping skills. These individuals also may be knowledgeable about resources for health education, financial services, social services, mental health counseling, transportation, and home visits.

Diabetes is stressful for both the children and their families. Parents should be alert for signs of depression or eating disorders or insulin omission to lose weight and seek appropriate treatment. While all parents should talk to their children about avoiding tobacco, alcohol, and other drugs, this is particularly important for children with diabetes. Smoking and diabetes each independently increase the risk of cardiovascular disease and people with diabetes who smoke have a greatly increased risk of heart disease and circulatory problems. Binge drinking can cause hyperglycemia acutely, followed by an increased risk of hypoglycemia. The symptoms of intoxication are very similar to the symptoms of hypoglycemia, and thus, may result in delay of treatment of hypoglycemia with potentially disastrous consequences.

Transition to Independence: Children with diabetes—depending on their age and level of maturity—will learn to take over much of their care. Most school-age children can recognize symptoms of hypoglycemia and monitor blood glucose levels. They also participate in nutrition decisions. They often can give their own insulin injections but may not be able to draw up the dose accurately in a syringe until a developmental age of 11 to 12 years.

Adolescents often have the motor and cognitive skills to perform all diabetes-related tasks and determine insulin doses based on blood glucose levels and food intake. This is a time, however, when peer acceptance is important, risk-taking behaviors common, and rebellion against authority is part of teens' search for independence. Thus, adolescents must be supervised in their diabetes tasks and allowed gradual independence with the understanding that the independence will be continued only if they adhere to the diabetes regimen and succeed in maintaining reasonable metabolic control. During mid-adolescence, the family and health care team should stress to teens the importance of checking blood glucose levels prior to driving a car to avoid hypoglycemia while driving. See NDEP online resources to help teen, young adults, families, and the health care team improve the transition process at <http://ndep.nih.gov/transitions/index.aspx>.

Diabetes at School: NDEP's *Helping the Student with Diabetes Succeed: A Guide for School Personnel* educates and informs school personnel about diabetes, how it is managed, and how each member of the school staff can help meet the needs of students with the disease. School principals, administrators, nurses, teachers, coaches, bus drivers, health care professionals, counselors, and office and lunchroom staff all play a role in helping students with diabetes succeed.

Several federal and some state laws provide protections to children with disabilities, including diabetes. These laws help ensure that all students with diabetes are educated in a medically safe environment and have the same access to educational opportunities as their peers – in public and some private schools. Students with diabetes are entitled to accommodations and modifications necessary for them to stay healthy at school. Accommodations may need to be made in the classroom, with physical education, on field trips, and/or for after-school activities.

Written plans outlining each student's diabetes management help students, their families, school staff, and the student's health care providers know what is expected of them. These expectations should be laid out in written documents, such as

- A Diabetes Medical Management Plan, developed by the student's personal health care team and family
- An Individualized Health Care Plan (or nursing care plan), developed by the school nurse presenting how the diabetes medical management plan will be implemented in the school
- Emergency Care Plans, which describe how to recognize hypoglycemia and hyperglycemia and what to do as soon as signs or symptoms of these conditions are observed
- Education plans, such as the Section 504 Plan, other Education Plan, or an Individualized Education Program (IEP) generated by the 504 or IEP teams to address each student's needs for services to manage their diabetes effectively in school

The school nurse is the most appropriate person to coordinate care for students with diabetes. Each student with diabetes should have a written Individualized Health Care Plan, developed by the school nurse, incorporating physician orders, parent requests, and tailored to the specific developmental, physical, cognitive, and skill ability of the child. The nurse will conduct a nursing assessment of the student and develop the plan, taking into consideration the child's cognitive, emotional, and physical status as well as the medical orders contained in the Diabetes Medical Management Plan. A team approach to developing the plan, involving the student, parent, health care provider, key school personnel, and school nurse, is the most effective way to ensure safe and effective diabetes management during the school day.

The Individualized Health Care Plan should also identify school personnel needed to provide care to an individual student, under the direction of the school nurse, when allowed by state nurse practice laws. The school nurse is responsible for training, monitoring, and supervising these school personnel. The school nurse will promote and encourage independence and self-care consistent with the student's ability, skill, maturity, and developmental level.

For more information on managing diabetes in the school setting, see NDEP's *Helping the Student with Diabetes Succeed: A Guide for School Personnel* at <http://ndep.nih.gov/publications/PublicationDetail.aspx?PubId=97>.

Camps and Support Groups. Local peer groups and camps for children and teens with diabetes can provide positive role models and group activities. Peer encouragement often helps children perform diabetes-related tasks that they had been afraid to do previously and encourages independence in diabetes management. Talking with other children who have diabetes helps young people feel less isolated and less alone in having to deal with the

demands of diabetes. They have the opportunity to discuss issues they share in common that others in their peer group can't understand, and they can share solutions to problems that they have encountered. Often, these programs challenge children physically and teach them how to deal with increased exercise, reinforcing the fact that diabetes should not limit them in their ability to perform strenuous physical activity.

Prevention Strategies for Type 2 Diabetes

For children and teens at risk, health care professionals can encourage, support, and educate the entire family to make lifestyle changes that may delay – or lower the risk for – the onset of type 2 diabetes. Such lifestyle changes include keeping at a healthy weight and staying active. New research findings will help determine effective ways to lower risk factors in high risk children. See NDEP's Tips for Teens: Lower Your Risk for Type 2 Diabetes (<http://ndep.nih.gov/teens/LowerYourRisk.aspx>) and NDEP's Diabetes HealthSense searchable database of tools, programs, and research that helps people make lifestyle and behavior changes (<http://ndep.nih.gov/resources/diabetes-healthsense>).

Research

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) conducts and supports a wide range of research aimed at finding ways to prevent and treat diabetes and its health complications. (See <http://www.niddk.nih.gov/health-information/clinical-trials/Pages/default.aspx>.) The Centers for Disease Control and Prevention (CDC) compiles diabetes statistics and conducts studies to help prevent and treat diabetes in children.

DirecNet: The Diabetes Research in Children Network (DirecNet) is a network of clinical centers working to determine the potential use of glucose monitoring technology and its impact on the management of type 1 diabetes in children. <http://direcnet.jaeb.org>

TEDDY: The consortium to identify The Environmental Determinants of Diabetes in the Young (TEDDY) is an international effort to identify infectious agents, dietary factors, or other environmental factors that trigger type 1 diabetes in genetically susceptible individuals. <http://teddy.epi.usf.edu/>

TrialNet: Type 1 Diabetes TrialNet (TrialNet) is an international network of researchers who are exploring ways to prevent, delay and reverse the progression of type 1 diabetes. Studies are available for people newly diagnosed with type 1 diabetes, as well as for relatives of people with type 1 diabetes who are at greater risk of developing the disease. www.DiabetesTrialnet.org

SEARCH: The SEARCH for Diabetes in Youth study is co-funded by CDC and NIDDK to determine the incidence and prevalence of diabetes in children in several of the U.S. and help clarify trends in the development of diabetes in youth. www.searchfordiabetes.org/

The National Collaboration on Childhood Obesity Research (NCCOR): NCCOR is a public–private initiative launched in 2009 to accelerate research and help reverse the childhood obesity epidemic. Partners include the NIH, CDC, Robert Wood Johnson Foundation, and the U.S. Department of Agriculture. NCCOR accelerates progress to reduce childhood obesity in the United States by maximizing outcomes from research, building the capacity for research and surveillance, creating and supporting the mechanisms and infrastructure needed for research translation and dissemination, and supporting evaluations. <http://www.nccor.org/>

TODAY Study: The TODAY (Treatment Options for type 2 Diabetes in Adolescents and Youth) study sought to identify the best treatment of type 2 diabetes in children and teens and was carried out in 13 medical centers and affiliated sites around the country. Participants are being followed longitudinally to better understand the course of type 2 diabetes and the development of complications in youth. https://today.bsc.gwu.edu/web/today/home?p_p_id=58&p_p_lifecycle=0&_58_redirect=%2F

HEALTHY Study: The HEALTHY study was an intervention in middle schools to lower obesity rates. Findings reported in 2010 reported lower obesity rate in students at highest risk for type 2 diabetes who started out overweight or obese in sixth grade. However, schools that implemented the program did not differ from comparison schools in the study's primary outcome—the prevalence of overweight and obesity combined—which had declined 4 percent in both groups of schools by the end of the three-year study. <http://www.healthystudy.org/>

Resources

For more information about diabetes, target goals for blood glucose levels, educational materials, and support programs for people with diabetes and their families and friends, contact the following organizations.

1. National Diabetes Education Program (NDEP)
1-888-693-NDEP (1-888-693-6337)
www.YourDiabetesInfo.org/schools
2. National Diabetes Information Clearinghouse
1-800-860-8747
<http://diabetes.niddk.nih.gov/>
3. Centers for Disease Control and Prevention
1-800-311-3435
www.cdc.gov/diabetes
4. American Association of Diabetes Educators
1-800-TEAM-UP4 (1-800-832-6874)
www.diabeteseducator.org
5. American Diabetes Association
1-800-DIABETES or 800-342-2383
<http://www.diabetes.org/living-with-diabetes/parents-and-kids/?loc=lwd-slabnav>
6. JDRF
(800) 533-CURE (2873)
www.jdrf.org
7. Children with Diabetes
www.childrenwithdiabetes.com
8. HealthCare.gov
1-800-318-2596
www.healthcare.gov
9. Joslin Diabetes Center
1-800-JOSLIN-1
www.joslin.org
10. American Academy of Pediatrics
1-800-433-9016
www.aap.org

See NDEP's [Resources for Diabetes in Children and Adolescents](#) for a listing of government agencies, professional organizations, and voluntary associations that provide information and resources related to diabetes in children and adolescents.

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